The Congruence of Theoretical and Empirical Patterns of Inter-Store Price Competition

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Abstract

The present paper concentrates on the nature and structure of inter-store price competition. It focusses especially on price competition between different retailers within one trading area and within one product category. Six theoretically founded hypotheses postulate competitive relations between manufacturers' UPCs and the retailers covering various possible competitive conditions such as competitive independencies or various degrees of competitive dependency among the UPCs and the retailers. These hypotheses have been tested empirically with store-level scanner data. UPC is the Universal Product Code, the most dominant coding technology in the United States. It allows for point-of-sale (POS) scanning systems and to continuously collect data by item at the retail level. The retail prices of 27 UPCs from a five stores suburban market place measured over 104 weeks are analyzed by using the three-mode component analysis to determine the basic and important competitive conditions in the market under study. On the basis of the estimated component structure of the UPCs, of the stores and of the weeks as well as on the basis of the core array, which provides the information of how the components of different modes (here UPCs, stores, and weeks) are related to each other the appropriateness of the six research hypotheses is tested. The empirical results support the theoretical implications that the price competition between UPCs and retailers in one product category and one trading area is primarily determined by manufacturers' pricing strategies. The manufacturer "set" the retail prices (shelf prices and temporary price reductions) by deciding on the number and size of the trade deals whereas the retailers exert passive pricing strategies by passing some or most of the trade deals through to their consumers.

KEYWORDS: Pricing Research, Game Theory, Price Competition among Manufacturers and Retailers, Empirical Industrial Organization

1. Introduction

This paper investigates the pattern of price competition among manufacturers' UPCs and retailers within one product category and one trading area. The research focusses in particular on the impact of UPCs' prices on the pricing strategies and the pricing behavior of competing UPCs in the same store or in competing stores. As such, pattern of price reactions and pattern of price discipline between UPCs and retailers will be investigated at the retail level. The results will provide additional insight into the nature and structure of price competition between manufacturers and retailers in a common trading area. This knowledge is important for the effective formulation of retail strategies and marketing tactics of both manufacturers and retailers. The research bases on (game) theoretically founded hypotheses about the pattern of inter-store price competition. In the empirical study their congruence is prooved with empirical indicators in order to derive conclusions about the nature of price competition at the retail level. The study is based on store tracking and scanner panel data from a five store (four chain) suburban marketplace.

The pattern of inter-store price competition determine to what extent stores' or retailers' prices affect the price competition between competing stores or retailers within the product category. A possible pattern of price competition could be a retailer dropping the price for an UPC when that same UPC is price-reduced by another retailer, but several other explanations are possible. One retailer might reduce the price of a larger size of the same brand (i.e. an UPC to a different UPC of the same brand reaction) or even react across different brands in the same category. Price changes at the retail level can therefore not only affect sales of the promoting brand and its competitors but may also cause competitive reactions that can result in an increase or decrease of competing brands' price pomotions. However, competitive reactions can occur simultaneously or – more realistically - at various time lags. The general rule of (positive) cross-store price elasticity of demand to indicate competition between retailers is for these reasons not specific enough to provide guidelines. The problem of price competition at the retail level is also related to the question, if one retailer can discipline the prices of another retailer by actions in a category that are unrelated to the brand being disciplined. Moreover, does market discipline have to occur simultaneously or is competitive response anywhere within the inter-purchase interval sufficient to discipline competitive prices? Price discipline across brands or across retailers can be regarded as (implicit) collusion of manufacturers or retailers in a given market. However, price competition at the retail level can also be determimed by manufacturers' actions. In that case, retailers' pricing decisions are managed by manufacturers and retailers do not engage in active pricing strategies. Hence price competition is driven by the manufacturers.

The investigation of the pattern of inter-store competition starts with a literature survey of empirical studies and game theoretical models that are related to the problem of inter-store competition. As a matter of fact, they did not focus primarily on the nature of price competition among UPCs and stores and the impact of prices within certain stores on the pricing strategies in competing stores. But certainly the literature review will provide the necessary framework for the development of hypotheses with respect to our research problem.

The empirical study is then conducted to test the theoretically founded research hypotheses. It is based on the retail prices from weekly store-level scanner data of different UPCs from one product category measured in different stores of one trading area. In difference to previous studies the pattern of inter-store price competition will therefore not be determined from the response of sales or market shares to the retail prices within and across stores but rather from an investigation of the retail prices themselves. We provide the three-mode component analysis as methodological framework to determine the pattern of inter-store competition. In our case the three-mode component analysis uncovers the basic competitive determinants across UPCs, stores and time and will enable us to understand the pricing behavior and the price competition between stores and UPCs. For this reason we will not only derive the hypotheses but also postulate their implications on a possible three-mode component solution.

Consistently the paper has the following structure. Section two will give a literature review on empirical studies and game theoretical models that can guide the development of the research hypotheses. Section three then provides the mathematical framework of the three-mode component analysis that is used within our empirical study to test the research hypotheses. The hypotheses, their reasoning and their implications on the possible three-mode component solution, are discussed in detail in the fourth section. Section five then presents the empirical study and the implications for the confirmation or rejection of the research hypotheses. The empirical study will prove the congruence of the theoretically postulated structure of the hypotheses with the empirically measured component structure of the three-mode analysis. The paper concludes in section six with a general discussion about the congruence of theoretical and empirical patterns of inter-store competition.

2. Literature Review

2.1 Empirical studies

Empirical studies have tackled the problem of inter-store price competition within the framework of store choice models and sales response models. With respect to our research problem we will consider the work of Bucklin and Lattin (1992), Walters (1991), Kumar and Leone (1988) and Leeflang and Wittink (1992).

To begin with, the effects of price promotions on the sales of brands within and across stores have been investigated by Kumar and Leone (1988) at the store-level. Contrary to the subsequently mentioned studies, Kumar and Leone can show that on the basis of their store-level scanner data and using a sales response model price promotions, featuring and display activities do not only increase the sales of that brand within the store but they also increase the substitution of stores and thus produce across store competitive effects.

Walters (1991) has investigated in his study the impact of retail price promotions on consumer purchasing patterns and the performance of competing retailers. On the basis of store-level scanner data Walters shows a significant effect of price promotion on the sales of the promoted brand within the store. These promotions have often effectively stimulated sales of complementary products within the store but the results do not support the hypothesis that the sales of a brand in one store are affected by price promotional activities of the brand or of its substitutes and complements in a competing store.

Bucklin and Lattin (1992) have proposed a model of product category competition between grocery retailers that bases on a brand choice model, a model of category purchase incidence and a store choice model. They combine these three models within a single framework and investigate determinants of store competition. Bucklin and Lattin, in particular, find indirect store competition caused by households that regularly visit more than one grocery store and by households that show purchase acceleration. It’s an interesting result that no direct effects of store-competition have been detected. The influence of within-category marketing activity, however, proves to be a direct effect on the probability of store choice.

Leeflang and Wittink (1992) have investigated competitive reactions to price and promotional activities using store-level scanner data. They distinguish between parallel movements, retailer-dominated and manufacturer-dominated reactions. Parallel movements are price activities of two brands in the same week which are characterized by a positive relation between competing prices of the brands. Retailer-dominated reactions may occur if a price decrease of one brand in a particular week is followed by a promotional activity of another brand in the following week. If retailer activities are motivated by manufacturers' trade promotions, the nature and frequency of such activities for competing brands may reflect competitive reactions by manufacturers. These reactions can only be observed if the retailers cooperate or if the channel is dominated by the manufacturers. In their empirical study Leeflang and Wittink use causality tests to establish direct and lag effects (up to 10 periods) of the promotional activities of one brand on the promotional activities of the other brands. The empirical results show that the estimated competitive reactions are very complex. Leeflang and Wittink report various causal relationships between brands within and across promotional instruments. In case of temporary price reductions the study reveals parallel price reactions, retailer-dominated short-run and long-run as well as manufacturer-dominated price reactions.

Though the approaches discussed above have shed some light on the nature of price competition between stores/retailers, they are not able to detect the real pattern of inter-store competition. The empirical study by Bucklin and Lattin (1992) and Walters (1991) as well as the study by Kumar and Leone (1988) use a priori defined response models to detect and measure the extent of store competition or store choice. These approaches decidedly depend on the correct specification of the possible patterns of inter-store competition. However, the patterns of inter-store competition especially are not known a priori and therefore response models may not reveal the true pattern. Competitive price reactions between stores may appear across UPCs or across brands and the time lags of a price reaction to competitive price movements may vary over time because stores may not be perfectly informed about temporary price changes in competing stores. The empirical study by Leeflang and Wittink is impaired by the fact that only aggregate scanner panel data are used. Conclusions about retailer- or manufacturer-dominated price strategies are derived from the causal relationship between prices across different time lags.

2.2 Game theoretical price models

Extant research on price and price competition have examined the effects of prices and price competition on sales and shares. E.g. inventory cost transfers and price discrimination have been postulated as possible reasons for the occurance of price promotions (e.g. Blattberg, Eppen & Lieberman 1981; Jeuland & Narasimhan 1985; Narasimhan 1984). With respect to the price competition between UPCs within and across stores game theoretical models may provide a valuable theoretical basis for investigating the nature of price competition (see also Moorthy 1985). Several established game theoretical models will be reviewed in the next paragraphs to develop research hypotheses about the pattern of inter-store competition.

Let us first consider a simple two-firm non-cooperative game. Firm A gets the highest pay-off if it is on price promotion and firm B offers at regular prices. Similarly, highest profits for firm B can be assumed if firm B is on price promotion and firm A sells at regular prices. If one firm receives the highest pay-off then the other firm will automatically receive the lowest possible profit. Both firms receive high profits if they do not engage simultaneously in price promotions and they get low profits if they perform price promotions within the same time-period. This pay-off scenario results in the well-known prisoner's dilemma in which both firms have incentives to price promote and therefore both firms will receive only small pay-off. The idea of the prisoner's dilemma has frequently been attributed to engagement of manufacturers and retailers in price promotions. With respect to the pattern of inter-store competition problem we might observe behavior according to the prisoner's dilemma if each store/retailer engages in price promotions every week for at least one of its UPCs of a particular product category.

However, the pay-off of price promotions should be higher if retailers or manufacturers coordinate their pricing strategies. Axelrod (1980a, 1980b, 1981) has investigated strategies for this type of game. He shows that a "tit-for-tat" strategy results in the highest profits. A firm that engages in a "tit-for-tat" strategy always follows the moves of its opponent, which means that the firm promotes if a competitor promotes and the firm stops promoting if the competitor stops promoting. However, with respect to the pattern of competition problem the manufacturers can only execute a "tit-for-tat" strategy if they control price and price promotions at the retail level which is rather unrealistic for frequently purchased products that are sold in department stores or grocery shops. If retailers are able to perfectly observe the pricing of competing retailers they may set up a pure “tit-for-tat” strategy. We can observe a “tit-for-tat” strategy at the retail level if the pricing strategies of two retailers are perfectly correlated. Looking into one product category, prices should be matched at the UPC-level as each retailer follows the pricing strategy of another retailer separately for each UPC within the product category.

Let us now consider another classical game, the battle of the sexes game. Two firms can earn asymmetric profits if both actions match, but they will earn no profits if their actions do not match. Each firm chooses its own strategy (shelf prices vs. price promotions). Assuming that a price promotion of firm A yields only profits if firm B runs a promotion for the same UPC at the same time period. The question will arise in which way a firm can implement collusive behavior among the manufacturers or retailers. If firms face this pay-off situation, price promotions should be positively correlated for each UPC. In addition to that it is also possible that promotions will not occur for a long time period. The pricing strategies of the stores should be almost matched for each UPC and within each time period. But the battle of the sexes game may also be interpreted in a way that firms can only realize high pay-offs if they do not promote at the same time. In that case the promotions will be negatively correlated and the stores should match their pricing strategies so that no UPC is on sale in more than one store at the same time.

So far we dealt with pure strategies only, the firms (manufacturer or retailer) execute a price promotion in a particular week or they don’t. In difference to a pure strategy the behavior of firms may also be investigated on the basis of mixed strategies. Firms follow a mixed strategy if they do not choose a certain strategy. Their market behavior is rather described by a probability distribution and the outcome of the game is the result of a random process.

Varian (1980) has developed a model on the basis of mixed strategy behavior in which temporary price reductions are used to discriminate between informed and uninformed consumers. Retailers charge low prices in a “randomizing” way in order to attract informed consumers. Uninformed consumers who accidentially go to a low-priced store cannot use this past knowledge of low priced stores to shop efficiently. Using the randomization argument, the Varian model fixes the optimal high or low prices which retailers should charge. Though Varian’s model may appear unrealistic, as retailers do not randomize their prices, the key concept is based on the condition that the consumers cannot anticipate when an item is promoted.

Narasimhan (1988) has developed a model that explains promotions through the existence of brand-loyal consumers and brand switchers. Manufacturers reduce prices for the retailers that then determine which promotion is to pass through. The retailer has a motivation different from that of the manufacturer. The retailer wants to attract traffic to the store or gain incremental sales for the category. Strong brands are more desirable for the retailers to promote because more consumers will purchase the product and consumers will be more likely to change stores to shop for a strong brand. Thus whereas the manufacturers of weak brands may promote more frequently, a higher percentage of their promotions will not reach consumers. On the other hand, the strong brands may promote less often, but in case they promote the retailers are more likely to pass the trade deal through.

Raju, Srinivasan and Lal (1990) have also introduced a mixed strategy model where differencies in brand loyalty are related to variations in the size and frequency of price promotions across brands. The loyalty of a brand is operationalized as the price differential needed to make consumers switch from their preferred brand to a competing brand. As a key result it is shown that in equilibrium the brand with larger loyalty promotes less frequently than the brand with lower loyalty. In addition to that, the likelihood of engaging in price promotions for certain brands increases as the number of brands in the product category increases. The model also predicts that weaker brands (brands with low loyalty) can gain more from price promotions.

The equilibrium outcome in Varian’s model as well as in Narasimhan’s model and in the model of Raju, Srinivasan and Lal is a mixed strategy. Each firm engages in probabilistic price promotions in a random manner. Competing firms are therefore uncertain about their competitors’ strategies. Competitors do not know competitors’ actions but only the probability of a possible action. Regarding the problem of the pattern of competition between manufacturers and retailers, price promotions are uncorrelated across UPCs and across stores if the stores are unconstrained in setting their prices. If the manufacturers set the retail prices, the price promotions will be correlated within brands and across stores but uncorrelated across brands and across stores.

Lal (1990) has extended the previous studies by introducing a third, regional brand. He investigates the influence of manufacturer trade deals on retail price promotions using the concept of price tiers with three manufacturers (two national brands, one local brand) and one retailer. In difference to the idea of interpreting a mixed strategy equilibrium as price promotion (Varian 1980; Narasimhan 1988; Raju, Srinivasan & Lal 1990) Lal models the competition between firms so that price promotions can be a result of a long-run profit maximizing equilibrium strategy. Consumers are assumed to be either loyals who buy national brands or switchers who buy on the price relation of the three brands. A fundamental result is that the national brands must alternate trade deals in order to serve the switching segment without having to offer a lower price to their loyal consumers all the time. The national brands cooperate to defend against the possible incursion by the local brand. The local brand forces the national brands to offer trade promotions, which in the absence of the local brand would not occur. The results also show that only one of the manufacturers of a national brand should offer a trade deal in any period. Given the fact that it is not in the retailer's interest to promote both national brands at the same time, manufacturers will decide on the frequency of promotions but may leave the sequencing decision to the retailer.

What is the effect if there are more than one retailer, e.g. two large grocery chain stores? In that case the customers are classified as store-loyal or as store hoppers and both may also be grouped as brand-loyal or brand switchers. Just as the national brands can cooperate in an infinite-horizon repeated game; the chain stores will have the same incentives to develop similar cooperation in setting the retail prices of the products. Both stores will charge the same price for all the products in every period, even if these prices will change in course of time (perfect Nash equilibrium). If the two bigger chain stores also compete against small stores it is optimal for them to collude. As a result temporal price dispersion exists within a store and spatial price dispersion across chain stores so that no national brand is promoted at the same time at both stores. The equilibrium outcome in Lal's model is an implicit collusion in a repeated game. The collusion is enforced through a purely non-cooperative mechanism (one facet of the Folk theorem, e. g. Friedman 1977). With respect to the pattern of competition problem the price promotions of the leading brands are negatively correlated.

These basic game theoretical models and their model instrinsic implications are now the basis for the development of our research hypotheses that will be tested in the empirical study. The research hypotheses will postulate possible pattern of inter-store competition and make assumptions regarding the price competition at the retail level. But before discussing these hypotheses we will discuss the methodological concept of the three-mode component analysis.

The three-mode component analysis will uncover and detect the pattern of price competition among the stores and therefore enable us to empirically test the theoretically founded hypotheses.

3. Research methodology

The data for the investigation of the pattern of inter-store competition are the retail prices of the UPCs in different stores across time. These data, collected from different UPCs within different stores across time form a three-dimensional array which is described by three different modes (UPCs, stores, and weeks) and where the term mode refers to different entities that build the three-way array (the data will be described in detail within the paragraph of the empirical study). This data array holds the key to understanding pricing behavior and price competition between stores and UPCs across time.

The price patterns of the UPCs indicate which UPCs follow an identical or similar pattern across time and which UPCs have identical or similar price patterns within different stores. These similar or identical patterns may provide the basis to aggregate these UPCs into entities of a higher level (e.g. sub-brands or brands). The price patterns of the stores indicate if the stores exert similar pricing strategies, if stores' pricing strategies are identical across time and if stores' pricing strategies are identical for all or a subset of UPCs. The weekly observations indicate which prices of the UPCs in the stores are regular prices or temporary price reductions. Thus, the weeks provide additional information about the pricing strategies of the stores and UPCs in the data set.

Numerous methods have been developed, primarily in the psychometric literature (e.g. Kiers 1991, Kroonenberg 1992) for the exploratory analysis of such three-mode, three-way data. The most general method that decomposes the three-way array into three sets of components is the Tucker3 model. Tucker (1966) proposed this model for the three-mode principal components analysis that reduces the dimensionality of all three modes to describe the information in the data. Algebraically the Tucker3 model can be written as

$$x_{ijt} = \sum_{p=1}^{P} \sum_{q=1}^{Q} \sum_{r=1}^{R} a_{ip} b_{jq} c_{tr} g_{pqr} + e_{ijt} \tag{1}$$

where x_{ijt} is an entry of the three-way data array with $i = 1,...,m$ UPCs, $j = 1,...,J$ stores and $t = 1,...,T$ time periods. For interpretational purposes it is convenient to express the Tucker3-model in matrix notation using the Kronecker product $(\otimes)$.

$$\mathbf{X} = \mathbf{AG}(\mathbf{C}' \otimes \mathbf{B}') + \mathbf{E} \quad (2)$$

$\mathbf{X}$ is a $(m \times TJ)$ – dimensional matrix where the prices of the m UPCs in the J stores are placed side by side for each of the T periods. a_{ip} is the (i, p) – element of the $(m \times P)$ – dimensional component matrix $\mathbf{A}$ which shows how strongly the *i*-th UPC is related to the *p*-th component among the UPCs. The coefficient b_{jq} is the (j, q) – element of the $(J \times Q)$ – dimensional component matrix $\mathbf{B}$ which shows how strongly the j –th store is related to the *q*-th store-component. The coefficient c_{tr} is the (t, r) – element of the $(T \times R)$ – dimensional component matrix $\mathbf{C}$ and shows how strongly the *t*-th week is related to the *r*-th week-component. $\mathbf{G}$ is the so-called core array which is itself a three-mode three-way array. The element g_{pqr} indicates how strongly component *p* of the UPC mode interacts with component *q* of the store mode and component *r* of the time mode.

Each squared element of the core array (g^2_{pqr}) indicates how much the combination of the *p*-th component of mode A, the *q*-th component of mode B and the *r*–th component of mode C contribute to the overall fit of the model (Kroonenberg 1983, p. 158). For the presentation of the empirical results we also have to emphasize that the three-dimensional core array can be sliced into frontal, horizontal and lateral two-dimensional core matrices. The frontal core matrices represent in our notation the relation of the P UPC-components with the Q store-components for a particular week-component. As such the horizontal core matrices indicate the relationship between the Q store-components and the R week-components for each UPC-component. The lateral core matrices on the other hand represent the relationship between the P UPC-components and the R week-components for each store-component. The model is usually not decomposed into all possible components, but only into the first *P*, *Q*, and *R* components, respectively, with $P < m, Q < J, R < T$, to provide a reduced-rank approximation. The elements e_{ijt} contain the errors resulting from the approximation. The model parameters can be estimated by the alternating least squares algorithm TUCKALS3 outlined by Kroonenberg and de Leeuw

(1980). For further details and a marketing application see also Cooper, Klapper and Inoue (1996).

4. Research Hypotheses

On the basis of the theoretical discussion about possible patterns of inter-store competition, we can now conduct various hypotheses regarding the pattern of competition between stores and UPCs/brands in order to answer the central research questions how retailers' prices affect the price competition between competing stores and whether the retailers' pricing decisions will discipline the pricing decisions of other retailers within the same product category (within and across UPCs and brands). With respect to the statistical methodology which will be applied to test the hypotheses we can also derive the implications of the research hypotheses on the component structure of the three-mode component model. This will enable us to verify or to reject the research hypotheses within the empirical analysis. All UPCs are assumed to belong to the same product category and some UPCs are part of a brand. The stores may belong to a retail chain so that pricing decisions may be determined by the chain rather than by the individual store itself. We assume an oligopolistic market structure, both for the manufacturers and for the retailers within on trading area. Thus manufacturers and retailers are competing within the same market for the same customers. The postulated hypotheses can be generalized across different markets. We do not postulate hypotheses regarding retailers' locations (e.g. Hotelling 1929) because in the oligopolistic market considered here we assume all retailers to compete with each other.

Hypothesis 1: Stores set their prices completely independently without any competitive constraints.

According to the results of Varian and Narasimhan and also Raju, Srinivasan and Lal the price promotions should be uncorrelated across UPCs and stores if the stores are unconstrained in setting their prices.

What are the implications of this hypothesis on the pricing strategies and the pricing behavior of the stores and the UPCs across time? The retail prices should be uncoordinated (and also uncorrelated) across stores if stores belong to different retail chains. With respect to the three-mode component analysis the store-mode should give as many components as there are retail chains in the data set. If, on the other hand, the stores of a chain are independent in their pricing behavior, we can expect as many store-components as there are stores. What are the implications of this hypothesis for the estimation of the UPC-components? If the prices of the UPCs are set without competitive pressures and independently of the prices of the other UPCs we then expect the prices of the UPCs within and across stores to be uncoordinated and uncorrelated. The three-mode component analysis should retain as many UPC-components as there are UPCs.

Two additional scenarios are possible. First, a store may coordinate the prices of the UPCs within a brand. In that case we can expect to get as many UPC-components as there are brands. A second alternative, however, is that the stores might coordinate the prices of their UPCs across brands according to additional features such as package sizes or flavors.

Which implications will arise for the week-components? Independent pricing strategies across UPCs (brands) and stores should result in as many week-components as there are independent pricing strategies. We will get week-components for each UPC in each store if a UPC engages in an unsystematical way in price promotions. If the number of UPCs times stores exceeds the number of weeks we can expect as many week-components as there are weeks.

According to hypothesis "1" the store-components, UPC-components and the week-components represent independent pricing behavior. Therefore the size of the entries in the core array can not vary substantially so that no UPC-component, store-component and week-component should dominate other three-mode combinations.

Hypothesis 2: The pricing strategies of the stores and UPCs are locked in a competitive situation according to a prisoner's dilemma.

According to this hypothesis price promotions for one UPC are offered in every week irrespectively to which brand the price-promoted UPC belongs although we expect in each week only one UPC of a brand on sale in each store as the brands (manufacturers) are also trapped into the pay-off situation described by the prisoner's dilemma. Therefore manufacturers will stimulate price promotions at the retail level by offering trade deals to the retailers in order to encourage them to pass the trade through to the consumers.

What are the implications of this hypothesis on the three-mode component structure? The prices of the UPCs should be uncoordinated across brands but we may get brand-components because manufacturers and retailers will coordinate the prices of the UPCs within brands. The analysis of the store-components should retain as many components as there are retail chains if the prices in a retail chain are coordinated. The component analysis of the weeks should give one dominant (general) week-component like a general component/factor that represents the high intensity of competition. In addition to this general component, some components of minor relevance should explain for the pricing behavior that is characteristic for certain UPCs and/or stores across the weeks.

The maximum of information in the core array is provided by the first frontal core slice that characterizes the interaction of UPC-components and store-components for the general component of the weeks. This first frontal core slice should have entries of equal size for all possible combinations of UPC-components and store-components. The other slices of the core array represent special interactions between store-components and UPC-components. The sizes of these core entries, however, should be small compared to the entries of the first frontal core slice.

<u>Hypothesis 3:</u> The pricing strategies of two retailers follow a “tit-for-tat” rule.

This hypothesis postulates that the pricing behavior of two retailers is perfectly matched. It is a pure strategy that assumes identical price movements for each UPC across different retailers. Stores that engage in a “tit-for-tat” strategy have identical price strategies across UPCs.

According to this hypothesis the three-mode component analysis will retain one store-component. We expect to get as many UPC-components as there are brands if the manufacturers coordinate their pricing strategies within brands. In addition to that, stores may also coordinate prices within brands. As all stores follow the same pricing strategy we should get as many week-components as there are different pricing strategies of the UPCs/brands (no more different week-components than there are UPCs in the data set). The two-dimensional core array will characterize the relationship between UPC-components and week-components. No assertions can be given for the entries in the core array.

Hypothesis 4: The pricing strategies of the stores are coordinated in order to maximize (joint) channel profits.

This hypothesis has to be inspected from two different standpoints. First, the pricing strategies of the stores could be matched for each UPC within and across time to realize the maximum profit. In that case the prices of the UPCs across stores will be positively correlated. Secondly, the pricing strategies are coordinated in such a way that no UPC is price-promoted in more than one store at the same time. In this case the prices of the UPCs within and across stores will be negatively correlated.

Which pattern can be expected in the three-mode analysis? Stores that coordinate their prices are represented in a common store component. The UPC-components may represent brand-components if stores or manufacturers coordinate the prices within brands. If the pricing strategies are positively correlated across UPCs we expect week-components that do not contrast the pricing behavior of the UPCs across stores. If on the other hand the prices of the UPCs are negatively correlated we expect to get contrasting week-components for these pricing strategies. As only one store component is retained the core array will be the two dimensional lateral core slice which characterizes the interactions of the UPC-components and the week-components. Its entries will be higher for the UPC-components and week-components combinations where the brands represented by the UPC-component and the brands whose price promotions are described by the week-components are identical.

Hypothesis 5: The manufacturers "set" the retail prices.

This hypothesis implies that in one way or other the manufacturer exerts an influence on the retail price. We interpret hypothesis "5" as such that the manufacturers have no direct influence on the shelf prices but may influence the number of price promotions at the retail level by offering trade deals to the retailers. Trade deals stimulate the retailers to pass the price advantage for one UPC or a couple of UPCs through to the consumers. However, manufacturers may not offer trade deals for all UPCs of their brands; they will eventually offer trade deals only for UPCs with relative high market shares (e.g. the most popular package size or the favorite flavor). Hence, the three-mode component analysis may find UPC-components that correspond to only a subset of the UPCs of a brand. As trade deals are usually offered by a lot of manufacturers to their retailers, several retailers may engage in price promotions for these UPCs that have been offered to them on deal. Therefore we may get UPC-components that are mixtures of promoted UPCs across brands. In that case we also expect to get store-components that refer to different store types, e.g. HLP-stores (store that engage in frequent price promotions with high and low prices) or EDLP-stores (stores with every day low prices and in general fewer price promotions than HLP-stores). The week-components should recover the price promotions of the UPCs, sub-brands, brands and vendors that appear in one, two or more or even in all stores in certain weeks stimulated by manufacturers' trade deals.

Which results do we expect for the core array then? If only one store component is retained in the three-mode analysis, the core array will be a two-dimensional matrix that characterizes the manufacturer dominated competition between the UPCs across time within the store-components. We can not give any assertions for the elements of the two-dimensional core matrix. If a store component for each store type is retained we will get a lateral core slice for each store type component. Assuming a three-mode component solution with an EDLP-store-component and a HLP-store-component the lateral core slice that represents the EDLP-store-component will have higher entries and (in terms of explained variation) also more important core relations for these week-components and UPC-components combinations in which the week-components represent price promotions of the HLP-stores. This expectation is based on the empirical observation that the deals of the HLP-stores offered to their consumers are expected to be more pronounced than in the EDLP-stores and therefore may affect the pricing of the EDLP-stores more sharply. The lateral core slice that represents the HLP-store, on the other hand, should contain the highest core entries and also the maximum of explained variations for these week-components and UPC-components combinations in which the week-components represent price promotions in the HLP-store. This assumption is founded on the empirical observation that EDLP-stores also engage less frequently in price promotions and that the deals offered to their consumers are not as pronounced as in the HLP-stores so that the price impact of price promotions in the EDLP-stores on the pricing behavior in the HLP-stores should not be as strong as vice versa.

Hypothesis 6: National brands implicitly coordinate their pricing strategies in order to compete against regional, local and store brands

This hypothesis implicates that price promotions of the leading national brands are negatively correlated because they are not promoted at the same time in the same store. This should result in as many UPC-components as there are leading national brands. Additional UPC-components may appear if the regional or local brands also engage in price promotions. We are not able to make any assumptions as to the number of store-components, but we may expect as many store-components as there are retail chains or as there are different store types. The week-components represent dominant competitive situations across time and we expect for each national brand - probably within each single store - a week-component that represents the pricing strategy of that national brand. In addition to these week-components that represent price activities of the national brands we expect some week-components that explain the pricing behavior of the regional, local or store brands. Which results can we assume for the core array then? It depends on the number of store-components. If we find one store component we should then get higher core entries for these UPC-components and week-components combinations where the brands represented by the UPC-components and the brands whose price promotions are described by the week-components are identical. If we assume as many store-components as there are store-types we may expect that the relationship between the UPC-components and the week-components as described for the one store-component solution holds within each slice of the core array.

5. The empirical study

5.1 The data

The data of our empirical study come from a five store (four chain) suburban market place. The product category is Frankfurters and we found a sample of 27 UPCs that are sold within all five stores over a period of 104 weeks. Missing prices due to zero sales have been filled up on the basis of past prices. All in all, 20.32 percent of prices were missing and had to be inserted into the data array. The mean prices of the 27 UPCs over the 104 weeks are given in Table 1. This table also gives a short description of the 27 UPCs with respect to vendor, brand and package size. Most of the UPCs are national brands and no store brands are included in the sample. The biggest

Table 1: Average prices (per oz) of the 27 UPCs in the 5 stores

No	VENDOR	ITEM	OZ	1419	1420	1422	1423	1424
1	FDL Foods Inc	Dubuque Plumpers	16	.144	.139	.100	.149	.186
2	Philip Morris Co Inc	Oscar Mayer	16	.141	.135	.148	.156	.155
3	Philip Morris Co Inc	Oscar Mayer Light	16	.145	.135	.153	.164	.169
4	Philip Morris Co Inc	Oscar Mayer Bun Leng	16	.175	.174	.181	.197	.197
5	Philip Morris Co Inc	Oscar Mayer	16	.176	.173	.179	.197	.197
6	Philip Morris Co Inc	Oscar Mayer Light	16	.179	.174	.180	.198	.198
7	Conagra Inc	Eckrich	16	.167	.167	.158	.198	.192
8	Conagra Inc	Eckrich	16	.136	.149	.134	.177	.175
9	Bakerite Foods Inc	Wilson Corn King	16	.068	.070	.069	.085	.085
10	Hygrade Food Prods	Hygrade Ballpark	16	.146	.131	.142	.164	.165
11	Hygrade Food Prods	Hygrade Ballpark	16	.138	.130	.140	.168	.169
12	Hygrade Food Prods	Hygrade Ballpark	16	.156	.153	.163	.193	.193
13	Hygrade Food Prods	Hygrade Grillmaster	16	.091	.082	.092	.098	.102
14	Bessin Corporation	Sinai 48	12	.231	.221	.270	.256	.256
15	Bessin Corporation	Sinai	16	.230	.222	.267	.250	.250
16	Bessin Corporation	Bests Kosher	12	.226	.228	.260	.267	.267
17	Bessin Corporation	Bests Kosher	12	.263	.244	.314	.302	.302
18	Bessin Corporation	Bests Kosher	12	.192	.228	.271	.262	.259
19	Bessin Corporation	Bests Kosher	16	.206	.206	.259	.261	.255
20	Bessin Corporation	Bests Kosher	40	.210	.214	.235	.231	.228
21	Bessin Corporation	Bests Kosher	40	.209	.213	.236	.226	.230
22	Bessin Corporation	Bests Kosher	16	.229	.237	.256	.233	.233
23	Bessin Corporation	Bests Kosher	16	.229	.224	.257	.235	.235
24	Vienna Sausage Mfg.	Vienna BEEF	12	.214	.209	.231	.239	.243
25	Philip Morris Co Inc	Louis Rich	16	.112	.109	.113	.125	.126
26	Philip Morris Co Inc	Oscar Mayer Bun Leng	16	.145	.133	.152	.164	.163
27	Hygrade Food Prods	Hygrade	16	.074	.065	.080	.096	.091

brands with respect to the number of corresponding UPCs are Oscar Mayer of Philip Morris (6 UPCs), Hygrade Ballpark of Hygrade Food (3 UPCs) and Bests Koshers of Bessin Corporation (8 UPCs). The five stores are labelled as 1419, 1420, 1422, 1423 and 1424 whereas stores 1423 and 1424 are of one chain. Prior analyses of the prices across UPCs and stores have revealed that store 1422 is a HLP-store with large price variations for most UPCs across time. The chain stores (1423, 1424) can be described as HHP-stores. Their average prices are above the average prices of the competing stores for almost all UPCs and their pricing behavior across time reveals frequent engagement in price promotions (s high-high price strategy). Stores 1419 and 1420 are on the other hand EDLP-stores. Their UPCs have lower average prices than in the competing stores and they have engaged in fewer price promotions and smaller price discounts over the period of 104 weeks.

5.2 The three-mode component analysis

The retail prices of the 27 UPCs in the 5 stores over 104 weeks build the three-mode, three-way data array for the investigation of the pattern of inter-store competition and it has been analyzed with the alternating least squares algorithm TUCKALS3. The TUCKALS3-solutions gives the parameter estimates of the Tucker3-model (see equations 1 and 2). Before applying the TUCKALS3-algorithm we had to decide on the number of components to retain in each mode. With respect to this problem we followed the advise of Tucker (1966). The singular values of each mode of the data set were estimated independently to help determine the proper number of dimensions in each mode. Therefore, the three-way array was first strung out in three different ways and singular value decompositions of the three different cross-product matrices were estimated. All the components prior to the last large drop in the first differences were retained. This analysis suggested to retain seven components to represent the UPC mode, two components to represent the store mode and eight components to represent the week-mode. The final TUCKALS3-solution explained 99.42 percent of the variance underlying the three-way array of prices.

All component matrices have been VARIMAX-rotated. In our case this rotation method coincides with the Harris and Kaiser (1964) ortho-oblique rotation that has proved to produce component matrices of low complexity (e.g. Hakstian 1971, Kiers & ten Berge 1994). The motivation for choosing this rotational transformation is to overcome the possibility of complex solutions (e.g. some UPCs with high component loadings on many components) because there are no strong hypotheses in favor for this kind of component structure. The length of each component has been scaled to be equal to the number of levels in the corresponding mode so that a value above 1 or below –1 will always indicate an above average influence of this level.

Let us now consider the component matrices of the UPCs, the stores and the weeks before interpreting the core array. Table 2 contains the VARIMAX-rotated pattern of the UPCs. In the bottom line of Table 2 we find the standardized component weight which represents the proportion of explained variation of the corresponding component. These weights add up to the standardized sums of squares (0.9942 in our case).

The UPC-component structure is mostly organized by brands or sub-brands. To begin with, the first component, accounting for 39.1 percent of the standardized sums of squares, represents the brands Bests Kosher and Sinai of Bessin Corporation (UPCs 14, 15, 20, 21, 22, 23) (also UPC 24 of Vienna Sausage). The 12oz Bests Kosher UPCs and one 16oz Bests Kosher are represented in the fourth UPC-component that accounts for 24.0 percent of the variation and that is a sub-brand component. UPC-component "2" accounts for 7.8 percent of the variation and represents both UPCs of Conagra's Eckrich brand. It is a brand and also a vendor component. The third UPC-component accounts for 7.6 percent of the standardized sums of squares and it represents the Oscar Mayer UPCs 2, 3, and 26 of Philip Morris. The other UPCs of Oscar Mayer (4, 5, 6) are represented in the additional component "7" that accounts for 8.7 percent of the standardized sums of squares. In this way Philip Morris's Oscar Mayer UPCs are split over two components and the components "3" and "7" therefore represent sub-brand components. UPC-component "5" is the Hygrade Ballpark component which accounts for 6.7 percent of the variation. It is interesting to note that component "5" is a brand component and not a vendor component because the other UPCs of Hygrade Food Products (UPC 13, 27) are not represented in this component. The last UPC-component to be discussed is UPC-component "6". It accounts for 5.4 percent of the sums of squares but it represents only UPC 1, Dubuque Plumpers, which is the only UPC of FDL Foods Incorporation. We can interpret this component as a brand and as a vendor component.

Table 2: VARIMAX-rotated component matrix of the UPCs

No	VENDOR	ITEM	OZ	C1	C2	C3	C4	C5	C6	C7
1	FDL Foods Inc	Dubuque Plumpers	16	-.21	-.03	.05	-.31	-.04	**4.98**	-.38
2	Philip Morris Co Inc	Oscar Mayer	16	.07	-.16	**3.39**	-.08	-.22	.05	-.27
3	Philip Morris Co Inc	Oscar Mayer Light	16	-.15	.08	**2.57**	.12	.09	-.03	.30
4	Philip Morris Co Inc	Oscar Mayer Bun Leng	16	.14	.14	.32	-.07	.03	.06	**2.54**
5	Philip Morris Co Inc	Oscar Mayer	16	.04	.08	.12	-.07	.06	.09	**2.97**
6	Philip Morris Co Inc	Oscar Mayer Light	16	.10	-.03	.10	-.04	.22	.16	**2.73**
7	Conagra Inc	Eckrich	16	.21	**2.99**	-.26	-.16	.00	.09	.28
8	Conagra Inc	Eckrich	16	-.22	**3.89**	.12	-.05	-.43	.01	-.15
9	Bakerite Foods Inc	Wilson Corn King	16	-.06	.57	.08	.16	.27	.45	-.02
10	Hygrade Food Prods	Hygrade Ballpark	16	.36	-.18	.03	-.23	**2.78**	.21	-.21
11	Hygrade Food Prods	Hygrade Ballpark	16	-.00	.10	-.01	.01	**3.25**	-.10	-.24
12	Hygrade Food Prods	Hygrade Ballpark	16	-.15	.19	-.08	.19	**2.64**	.09	.55
13	Hygrade Food Prods	Hygrade Grillmaster	16	.51	.44	.30	-.09	.16	.24	-.32
14	Bessin Corporation	Sinai 48	12	**1.81**	.29	-.02	.40	.17	-.27	-.39
15	Bessin Corporation	Sinai	16	**1.89**	.03	.01	.30	.12	-.25	-.17
16	Bessin Corporation	Bests Kosher	12	-.40	-.13	-.48	**2.77**	-.41	.75	.97
17	Bessin Corporation	Bests Kosher	12	.60	-.36	.44	**2.41**	.02	.26	-.55
18	Bessin Corporation	Bests Kosher	12	-.43	-.08	.12	**3.20**	.21	-.14	-.24
19	Bessin Corporation	Bests Kosher	16	.48	1.02	-.12	**1.61**	.09	-.40	-.14
20	Bessin Corporation	Bests Kosher	40	**1.70**	-.05	-.01	-.12	.20	.14	.27
21	Bessin Corporation	Bests Kosher	40	**1.78**	.03	-.02	-.10	.15	.02	.15
22	Bessin Corporation	Bests Kosher	16	**2.40**	-.44	-.08	-.15	-.69	.40	.08
23	Bessin Corporation	Bests Kosher	16	**2.30**	-.14	.05	-.17	-.36	.07	-.11
24	Vienna Sausage Mfg.	Vienna BEEF	12	**1.17**	.38	-.14	.16	.27	.37	.49
25	Philip Morris Co Inc	Louis Rich	16	.33	.19	-.08	.22	.04	.71	.30
26	Philip Morris Co Inc	Oscar Mayer Bun Leng	16	-.05	.04	**2.75**	.02	-.01	-.09	.23
27	Hygrade Food Prods	Hygrade	16	.15	.77	.77	.10	.59	.16	-1.14
Standardized Component Weight:				.391	.078	.076	.240	.067	.054	.087

Table 3: VARIMAX-rotated component matrix of the stores

Store	Type	C1	C2	C3
1419	(EDLP)	-.17	-.13	1.85
1420	(EDLP)	.17	.13	1.25
1422	(HLP)	-.01	2.22	.04
1423	(HHP)	1.58	.10	-.05
1424	(HHP)	1.57	-.10	.12
Standardized component weight		.436	.208	.350

Table 4: Key results of the week-component matrix structure

Week-Component	Explained Variation	UPCs	Stores
1	15.38	PPs of UPCs 1, 2, 8, 16, 18	1419
		PPs of UPCs 6, 20	1423, 1424
		SPs of UPCs 1 to 12, 26, 27	1422
2	11.16	PPs of Oscar Mayer UPCs (2, 3, 26)	1423, 1424
3	16.43	PPs of all UPCs of Oscar Mayer	1422
4	16.92	PPs of Eckrich	1422
		SPs of Hygrade Ballpark and Oscar Mayer	1422
5	6.97	PPs of 12oz Bests Kosher	1423, 1424
6	12.36	PPs of Hygrade Ballpark	1422
7	10.18	PPs of Oscar Mayer	1422
		SPs of Hygrade Ballpark	1423, 1424
8	10.02	PPs of Hygrade Ballpark	All stores

PP = Price promotion SP = Shelf prices

Three components are retained in the store-mode (Table 3) of which the first accounts for 43.6 percent, the second for 20.8 percent and the latter for 35.0 percent of the variation. The overall store-component structure reveals that the store-components belong to store-types. The first component obviously represents stores 1423 and 1424, which are HHP-stores. The second component is the HLP-store-component (store 1422) and the third store-component is the EDLP-store-component (stores 1419, 1420).

The interpretation of the VARIMAX-rotated component matrix of the weeks is very complicated because a 104 by 8 matrix has to be interpreted. As mentioned before, the interpretation of the component loadings has to be done in accordance with the prices and the temporary price reductions that happen in certain weeks and stores for certain UPCs. For that reason we have correlated the component loadings with the prices of each UPC in each store as guide line for our interpretation of the week-component matrix and summarized the key results in Table 4.

The discussion about the key results of the core array is given for the lateral core slices which represent the inter-structure of the UPC-components and the week-components for the three store-components (Table 5). We will focus our attention on the explained variation provided by certain component combinations rather than on the core array elements themselves.

The first lateral slice represents the HHP-store-component. Within this HHP-component all the week-components are related to the first UPC-component. In addition to that, the fourth UPC-component is related to week-components 1 to 4 and 6 to 8. These two UPC-components (1 and 4) together represent all the UPCs of Bessin Corporation, which indicates that the HHP-stores temporarily reduce the prices of Bessin Corporation’s UPCs. The analysis of the core slice representing the HLP-store-component reveals that the first and fourth UPC-component are especially related to the week-components 3 and 4. Our conclusion is that the prices of Sinai’s and Bests Kosher’s UPCs of Bessin Corporation are affected by the prices of the UPCs of the brands Oscar Mayer, Eckrich and Hygrade Ballpark in the HLP-store which again indicates strong competition between the major brands in that store. The third lateral core slice which represents the EDLP-store-component reveals that the UPC-component of the brands Sinai and Bests Kosher (UPC-component 1 and 4) are highly related to all week-components indicating that the prices of these brands within the EDLP-stores are highly affected by price promotions in the HLP-stores and in the HHP-stores.

Table 5: Lateral Slices of the Core Array (Explained Variation in Percent)

Lateral slice: Store-Component 1 (HHP-store-component)

Week-Component	*UPC-Component* 1	2	3	4	5	6	7
1	2.33	.63	.63	1.63	.49	.39	.54
2	1.79	.38	.11	1.28	.37	.29	.44
3	2.61	.66	.63	1.87	.50	.43	.66
4	2.63	.65	.62	1.89	.55	.45	.66
5	1.19	.32	.21	.41	.27	.17	.29
6	1.97	.43	.47	1.37	.43	.33	.46
7	1.65	.33	.41	1.14	.43	.27	.35
8	1.66	.44	.37	1.18	.25	.27	.42

Lateral slice: Store-Component 2 (HLP-store-component)

Week-Component	*UPC-Component* 1	2	3	4	5	6	7
1	1.31	.29	.37	.80	.24	.22	.28
2	1.02	.18	.16	.72	.12	.06	.20
3	1.43	.30	.12	.96	.26	.07	.16
4	1.47	.09	.30	.96	.31	.07	.36
5	.67	.08	.10	.38	.07	.05	.12
6	1.11	.20	.23	.66	.05	.05	.28
7	.93	.08	.08	.58	.10	.15	.09
8	.87	.08	.16	.57	.05	.05	.14

Lateral slice: Store-Component 3 (EDLP-store-component)

Week-Component	*UPC-Component* 1	2	3	4	5	6	7
1	2.25	.39	.46	1.01	.36	.28	.47
2	1.65	.30	.29	.93	.26	.24	.38
3	2.40	.46	.42	1.24	.35	.34	.54
4	2.37	.44	.44	1.41	.36	.34	.54
5	1.08	.20	.20	.57	.17	.16	.24
6	1.74	.32	.32	.99	.29	.27	.41
7	1.48	.26	.26	.79	.28	.21	.33
8	1.52	.29	.26	.72	.17	.21	.34

The general structure of all three lateral core slices also reveals that the week-components that refer to price promotions in HLP-stores are more influencial on the UPC-components than the week-components that represent price promotions in the HHP-stores and EDLP-stores. This refers to stronger competitive impacts of the price promotions in the HLP-stores on the prices in the HHP-stores and the EDLP-stores.

5.3 Implications of the component and core structure on the hypotheses

On the basis of the previous discussion about the component structure and the core array structure we know that we will get as many store-components as there are store types (EDLP-stores, HLP-stores, HHP-stores). The UPC-component matrix reveals a structure that summarizes UPCs to brand-, sub-brand- and vendor-components. The component structure does not reveal mixtures of UPCs across brands and vendors within a UPC-component. The week-components stand for the dominant price activities of certain brands, sub-brands or UPCs in some or all the stores over the period of 104 weeks. The pattern of the core array indicates that several combinations of the P UPC-components, the Q store-components and the R week-components are more dominant than are other combinations.

The theoretical expectations for the component structure and the core array have been given in section three and are summarized in Table 6. This table also provides the information whether the theoretical expectations within each hypothesis are fulfilled or not. As can be seen from Table 6 the three-mode component solution does not support hypotheses “1”, “2”, “3”, “4” and “6” although the theoretical assumptions are partially met for some component matrices. However, we have to ascertain that the assumptions of hypothesis “5” are supported by the empirical results. Our three-mode component solution is in congruence with the hypothesis that the manufacturers have a big impact on the final retail prices (shelf prices and deal prices) by influencing the number of price-promotions and the prices at the retail level by offering trade deals to the retailers.

Table 6: Theoretical expectations of the 6 research hypotheses on the three-mode component structure and their empirical prove

Hyp.	Mode	Theoretical expectations	Prove
1	UPCs	As many UPC-components as there are UPCs or brands	✔
	Stores	As many store-components as there are stores or retail chains	-
	Weeks	As many week-components as there are UPC-store-combinations	-
	Core	No dominant component combinations	-
2	UPCs	As many UPC-components as there are UPCs or brands	✔
	Stores	As many store-components as there are stores or retail chains	-
	Weeks	One dominant week-component	-
	Core	First frontal core array provides the maximal information	-
3	UPCs	As many UPC-components as there are UPCs or brands	✔
	Stores	One common store-component	-
	Weeks	As many week-components as there are different pricing strategies of the UPCs/brands	-
	Core	No assertions	?
4	UPCs	As many UPC-components as there are UPCs or brands	✔
	Stores	One common store-component	-
	Weeks	Contrasting/Non-contrasting week-components for negatively/positively correlated UPC pricing strategies	
	Core	Higher entries in each lateral core slice for these UPC-components and week-components combinations where the brands represented by the UPC-components and the brands whose price promotions are described by the week-components are identical	-
5	UPCs	As many UPC-components as there are UPCs, brands, sub-brands or vendors	✔
	Stores	As many store-components as there are store-types	✔
	Weeks	Week-components should represent price promotions of various UPCs, sub-brands, brands and vendors within one or more stores	✔
	Core	Higher elements in each lateral core slice for these week-components and UPC-components combinations in which the week-components represent price promotions of the HLP-store-type	✔
6	UPCs	As many UPC-components as there are brands, plus some UPC-components for the regional and local brands	✔
	Stores	As many store-components as there are retail chains or store-types	✔
	Weeks	Week-components that represent the pricing activities of the national brands and some week-components that explain the pricing strategies of the regional or local brands	-
	Core	Higher entries in each lateral core slice for these UPC-components and week-components combinations where the brands represented by the UPC-components and the brands whose price promotions are described by the week-components are identical	-

✔ /- indicate that the theoretical expections are empirically detected/not detected

6. Conclusions

In the present paper the pattern of inter-store competition has been investigated. We have focussed our attention primarily on the price competition between different retailers within one trading area and within one product category with special attention on the price impacts between UPCs within and across stores to determine the extent of price competition.

On the basis of theoretical models that describe the possible pattern of price competition between UPCs and/or stores across time we have deduced six hypotheses. These six hypotheses postulate different competitive relations between manufacturers' UPCs and the retailers, covering different possible competitive conditions such as competitive independencies or various degrees of competitive dependency among the UPCs and the retailers. The theoretically derived assumptions of our research hypotheses have been tested empirically with store-level scanner data from a five-stores (four chain) suburban market place as basis for our empirical analysis. The prices of altogether 27 UPCs in the five stores over 104 weeks have been analyzed by using the three-mode component analysis to determine the basic and important competitive conditions in the market under study. On the basis of the empirically estimated component structure of the UPCs, the stores and the weeks as well as on the basis of the core array, which provides the information of how the components of different modes (here UPCs, stores, and weeks) are related, we were able to investigate the appropriateness of our six research hypotheses. The empirical results support the theoretical implications of hypothesis "5" whereas they discard the other five hypotheses. The fifth hypothesis postulates competition between UPCs and retailers in such a way that the final retail prices are primarily determined by the manufacturers' pricing strategies. Manufacturers are assumed to "set" the retail prices. We have to mention at this point that the manufacturers do not fix the actual retail price directly, they rather influence the shelf prices and the number of retailers' price promotions by offering trade deals to the retailers. The retailers exert a passive pricing strategy by passing some or most of the trade deals through to the consumers in that they offer the trade-dealt products at reduced prices to their consumers. Therefore the manufacturers manage ("set") the final retail price by deciding on the number and the size of the trade deals.

The competitive component analysis also shows that price promotions in the EDLP stores and in the HHP-stores do not affect the prices in the HLP-stores as sharply as the price promotions in the HLP-stores would affect the prices in the EDLP- and HHP-stores. The component analysis of the UPCs reveals that the manufacturers coordinate the prices within the whole brand or within sub-brands. These sub-brands are determined on brand characteristica such as package size or brand varieties.

To summarize, the three-mode component analysis has enabled us to investigate the pattern of inter-store competitions. We have revealed interesting empirical results that are theoretically founded. A limitation of the analysis is its purely exploratory character. On the basis of the theoretically derived hypotheses future work may determine a possible component structure and possible core array structures. These theoretically established three-mode component structures could then be estimated within a confirmatory three-mode component analysis to determine whether the theoretically derived three-mode component solution is in acccordance to empirically observed price pattern.

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